

SCTE ISBE CABLE-TEC
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Head End Re-Architected as a Datacenter

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 #CableTecExpo

Essential Knowledge for Cable Professionals™

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- Head End Re-Architected as a Datacenter (HERD)
- Applying datacenter virtualization concepts and economics to the head end
- Based on the work done by the Central Office Re-architected as a Datacenter (CORD) consortium applied to MSOs
 - First application of ON.LABs Open Network Operating System (ONOS) for service providers
 - ONOS describes itself as the open-source SDN networking operating system for service provider networks



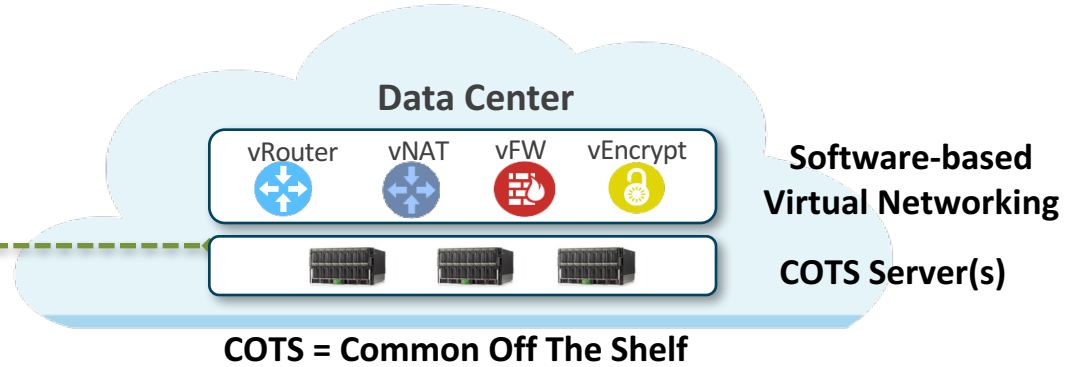
- An open source SDN project
- Based at ON.Lab in Palo Alto, CA
- Sprang from Stanford research effort
- First Release Dec 2014
- Driven By Carriers and Vendors
 - ATT, NTT, SKT, Verizon
 - Ciena, Cisco, Ericsson, Huawei, Fujitsu
- Goal: “Re-enable innovation for both network hardware and software, independently, on their own time scales”

- Carrier grade (distributed + High Availability HA)
- OpenFlow 1.3 support
- Northbound Interface (NBI) abstraction
 - Flow intents, network graph, config services, Web-style
- Southbound Interface (SBI) abstraction
 - Pluggable protocols
 - Enables legacy interfaces
- Enables migration from legacy to white-box
- Software modularity (ONOS Apps)

What is CORD?

ONOS use case:

Central Office Re-architected as a Data Center



Customer Premises



Router



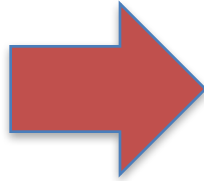
Firewall



VPN

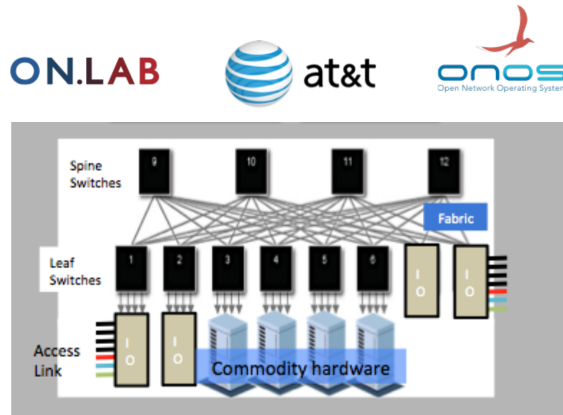


NAT

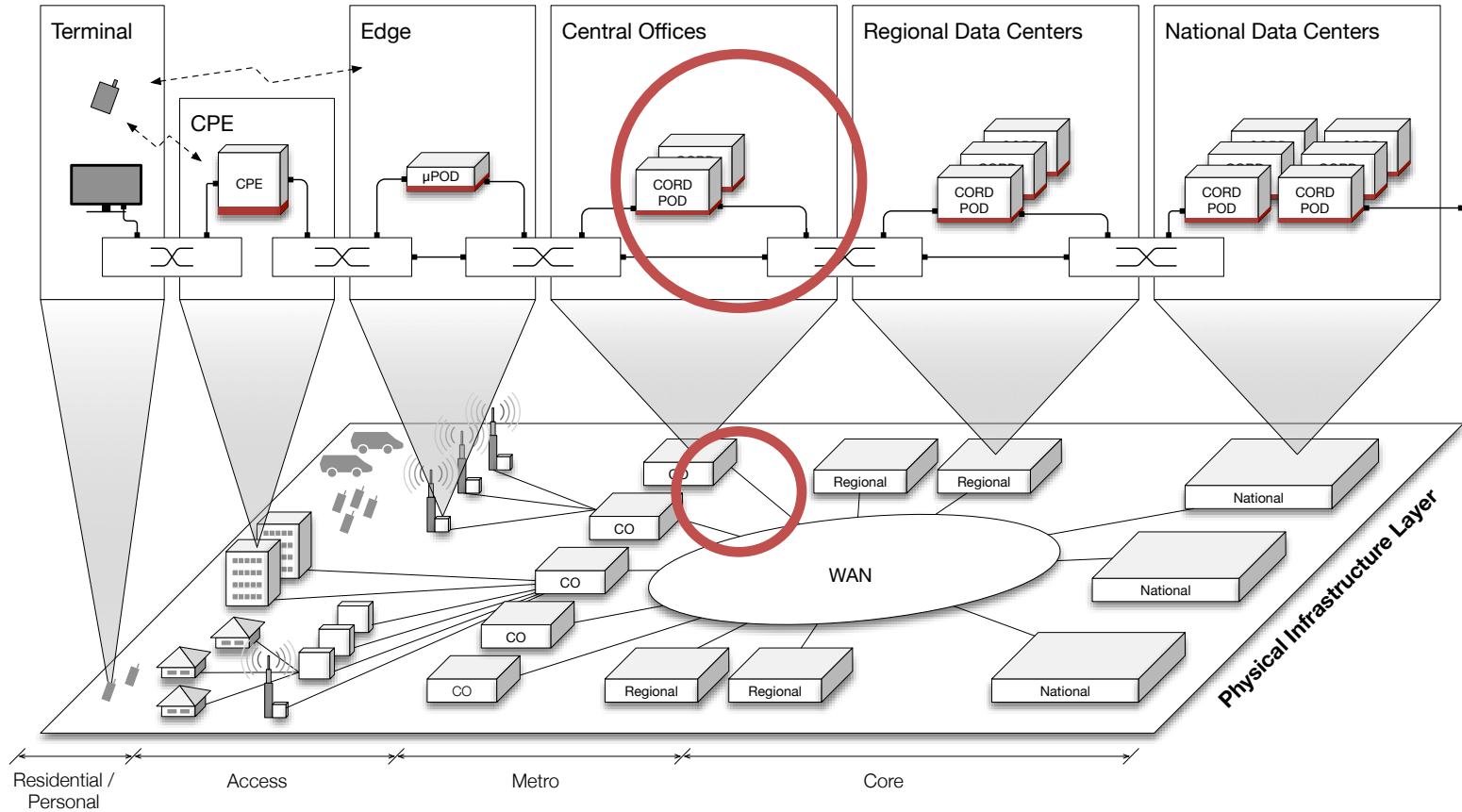


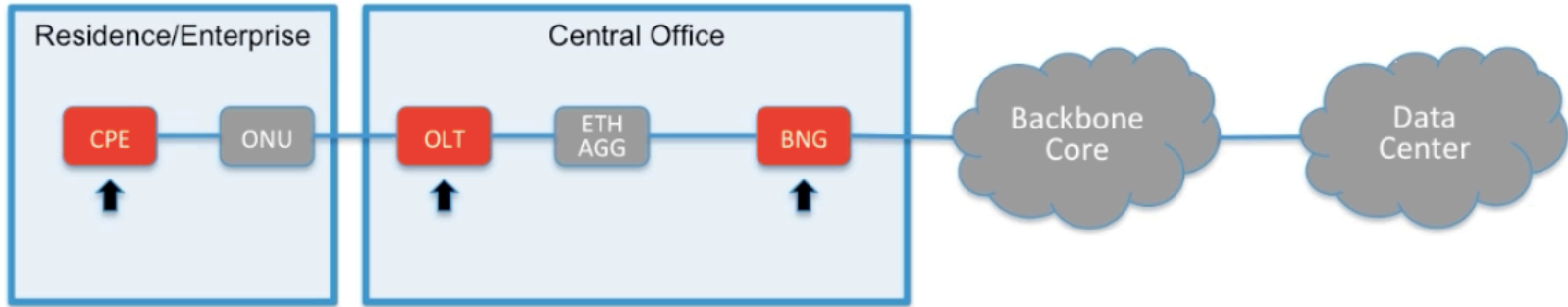
- Service Providers can virtualize network functions
- vCDN, vRouter, vFirewall, etc., are software instances that run on virtual machines in the data center on low-cost COTS hardware
- Network operators can develop, operationalize and deliver new services much more rapidly
- The datacenter, not the central office, becomes the critical location in the operator network from which to drive services

- ON.Lab and the ONOS open-source project have developed CORD
- First major ONOS use case with support from the market
- Brings cloud economics and agility to the service provider central office
- Replaces the fragmented, proprietary infrastructure of the traditional CO with open, commoditized software and hardware building blocks



- White box data center switches**
- Carrier-grade open-source SDN control plane**
- OpenStack virtual infrastructure management**
- Vendor-agnostic control and management**



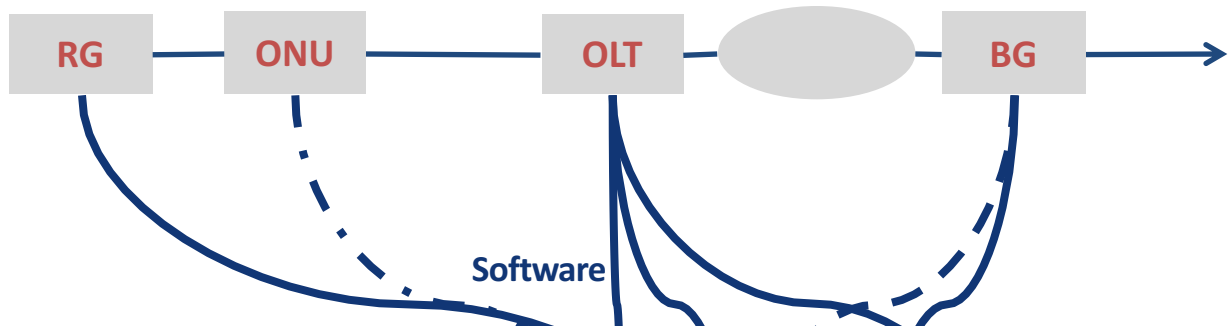


Acronyms

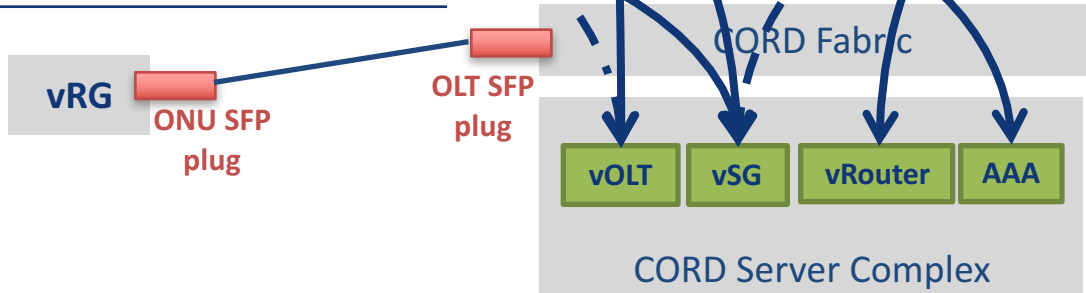
- CPE – Customer Premises Equipment
- OLT – Optical Line Termination
- BNG – Broadband Network Gateway

Legacy solution: Hardware based Physical Appliances

RG = Residential gateway
 ONU = Optical Network Unit
 OLT = Optical Line Terminal
 BG = Broadband Gateway

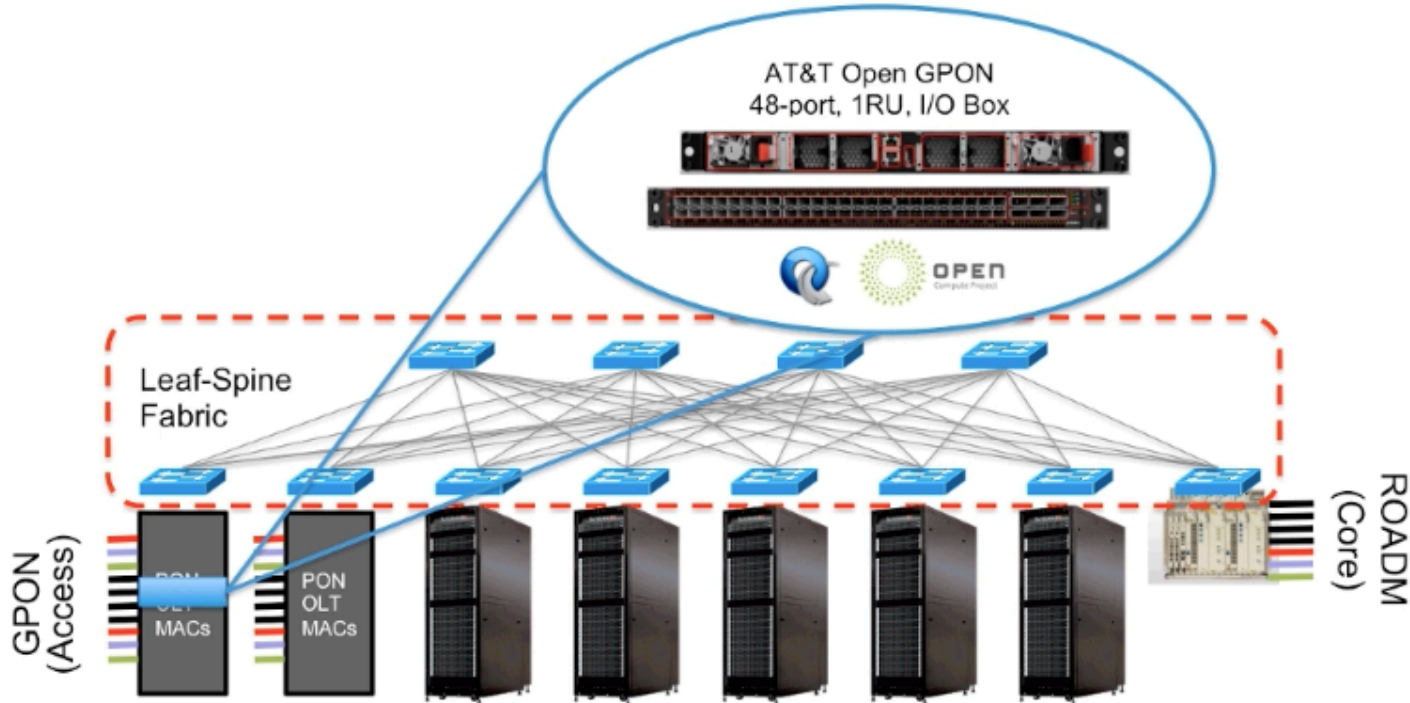


CORD: Virtual Network Functions

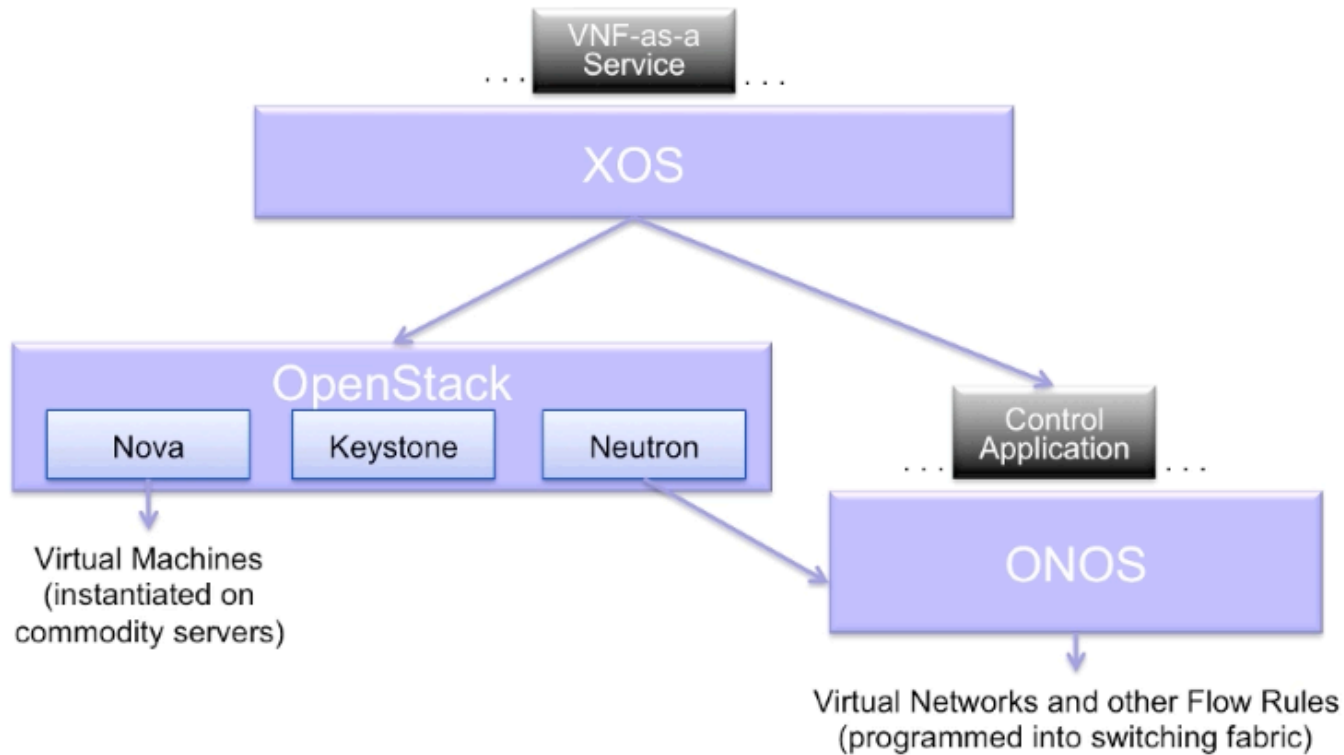


vOLT = virtual OLT
 vRG = virtual Residential Gateway
 vSG = virtual Subscriber Gateway
 AAA = Admin, Authorization, Authentication

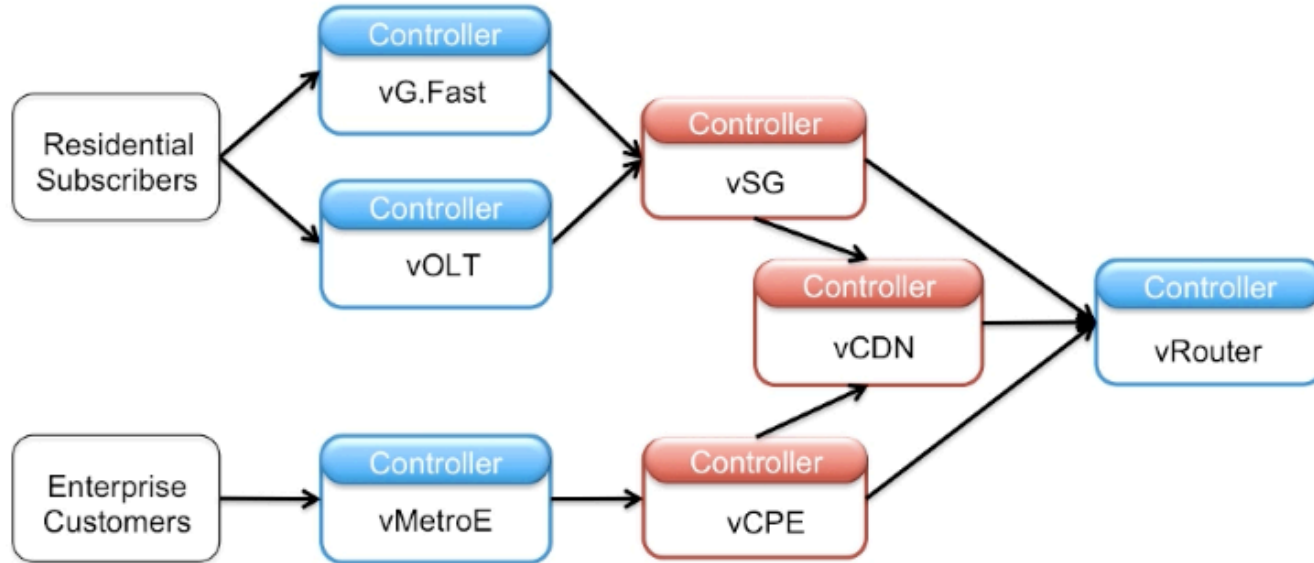
CORD – Hardware Architecture



Commodity Servers, Storage, Switches, and I/O



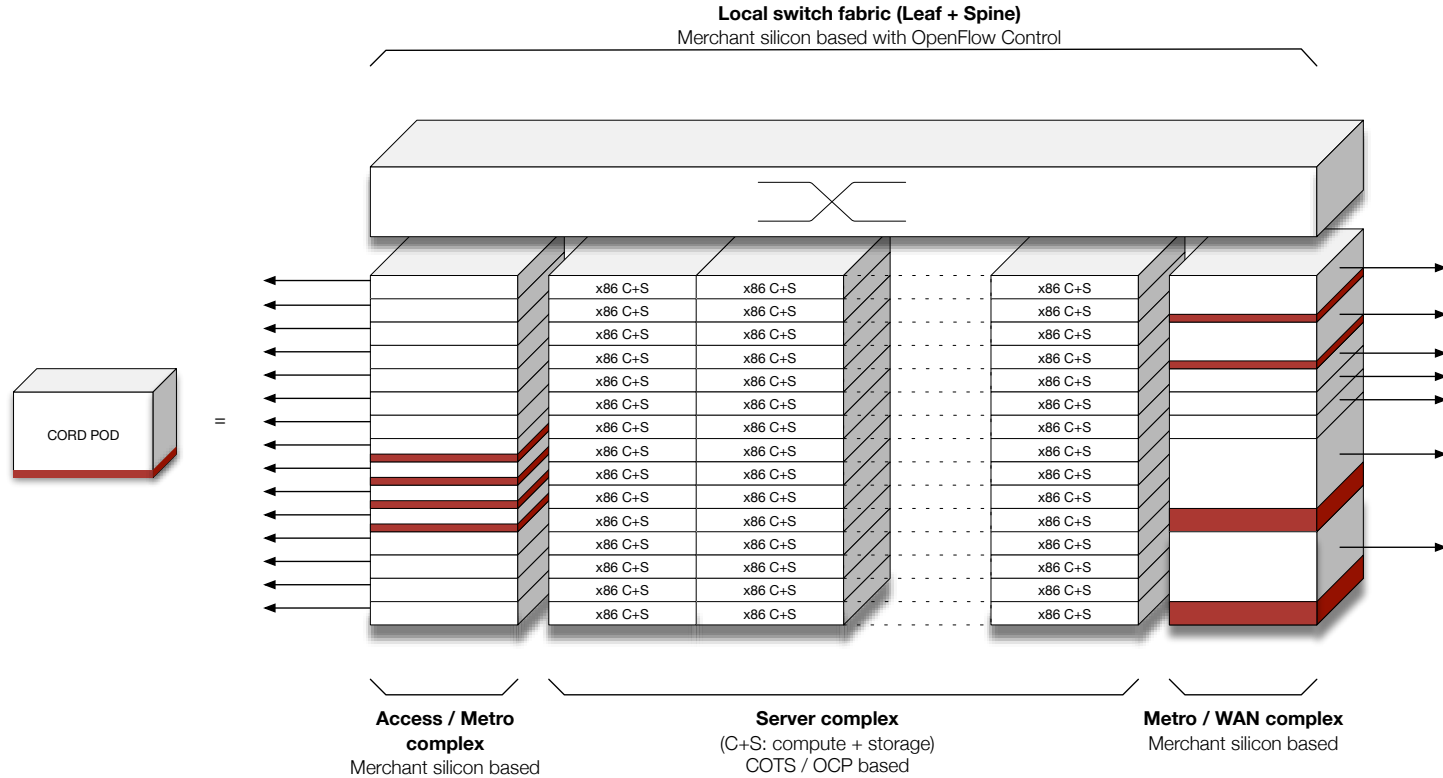
Extensible By Design



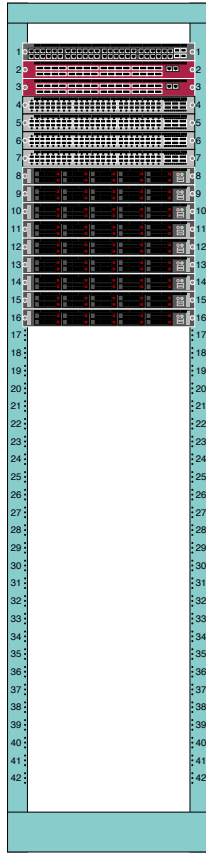
CORD POD: a universal building block

CORD POD

- A standard unit of deployment
- Mini datacenter
- Different sizes
- Technology update every 3-12 months
- Upgrade is independent of service/function
- Hot expandable
- Design tools



Example: Small POD (μ POD) for ~5K Subscribers



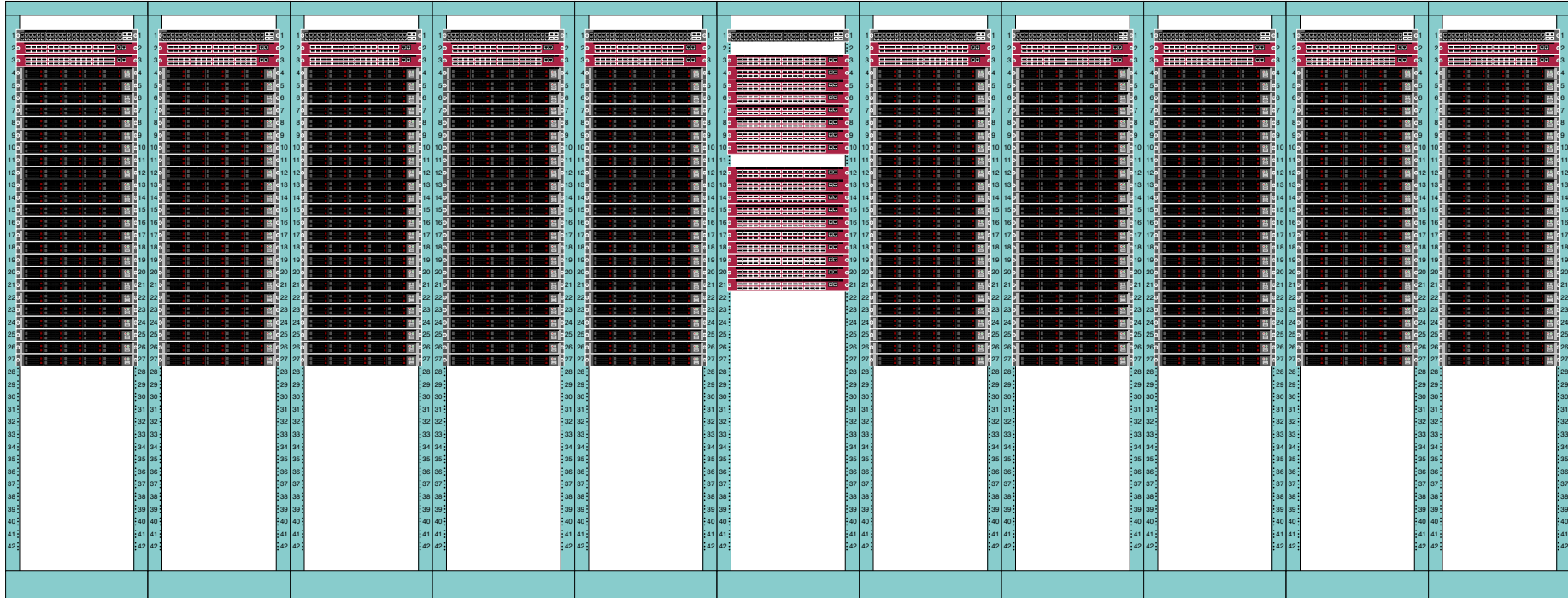
Most compact design

- 1 management switch
- 2-4 fabric switches
- 4-16 GPON pizza boxes
- 9 CORD servers
- All copper cabling (DAC for 40G)

- < 1/2 rack (16 RUs)

Small enough that it can be in a conditioned enclosure (indoor or outdoor).

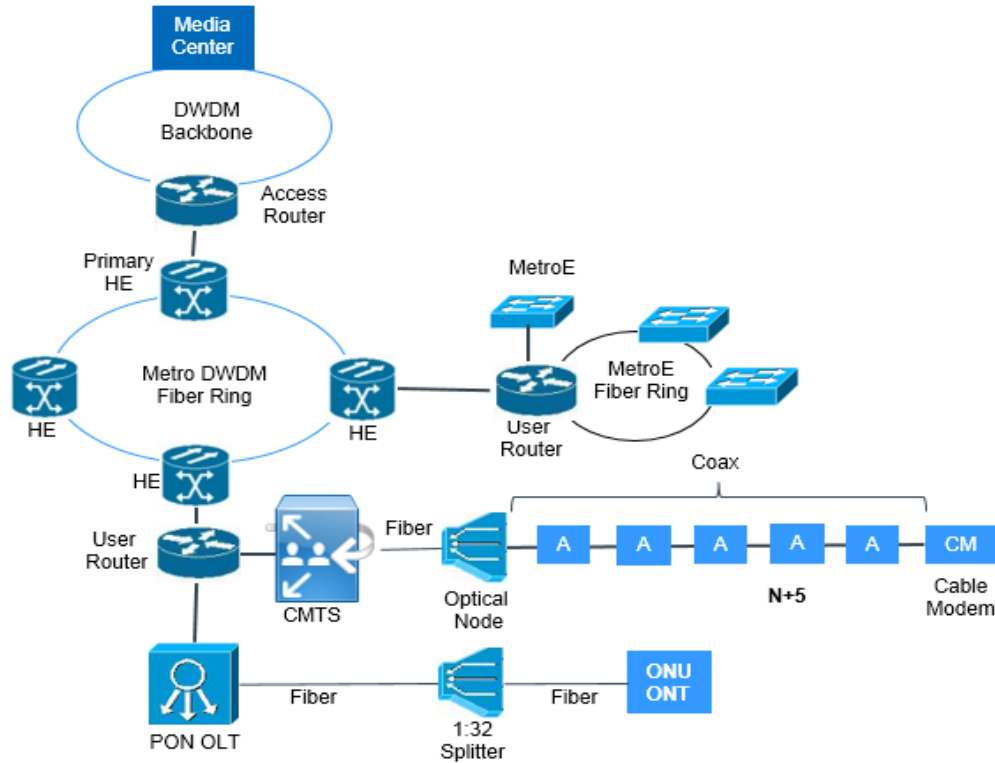
Example: Large Size POD for ~200K Subscribers



What is HERD?

ONOS use case:

Head End Re-architected as a Data Center



Physical Appliances

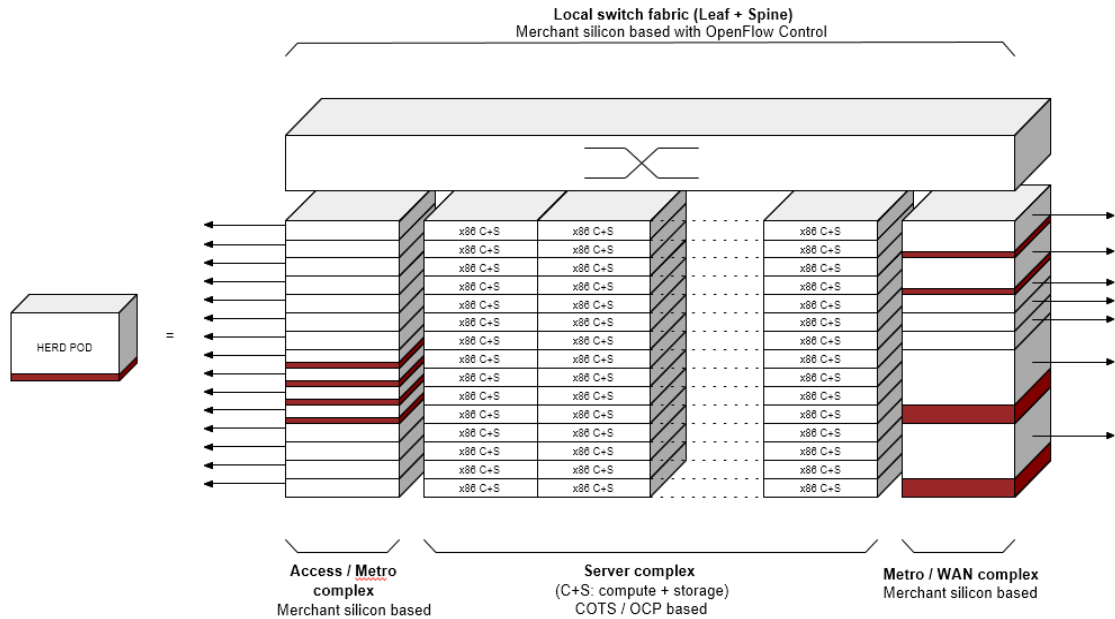
Routers

CMTS moving to CCAP

PON OLT

Subscriber Gateway

- Scale by adding physical appliances
- Vendor lock-in
- Long order, deliver, install cycle
- Can not respond quickly to changing network demands



Virtual Appliances

vRouters

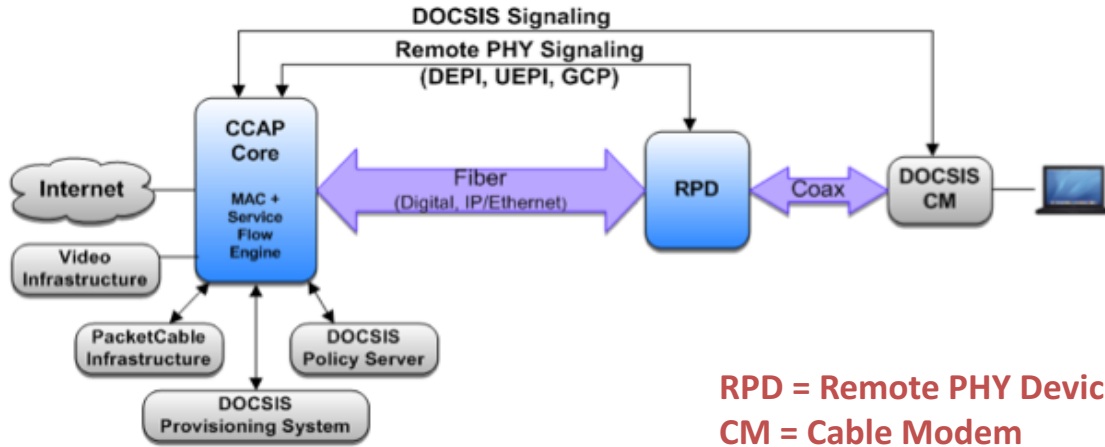
vCCAP

PON vOLT

vSubscriber Gateway

- Use COTS Servers and white box switches
- Scale with VMs and containers
- No vendor lock-in
- Respond quickly to changing network demands

In the future, CCAP devices become more disaggregated into virtual CCAP.



RPD = Remote PHY Device
CM = Cable Modem

virtual CCAP (vCCAP)

functionality including

- vCable Control Plane
- vSubscriber Management
- vMAC
- vService Flow Engine
- vDOCSIS Policy Engine
- vDOCSIS Provisioning System

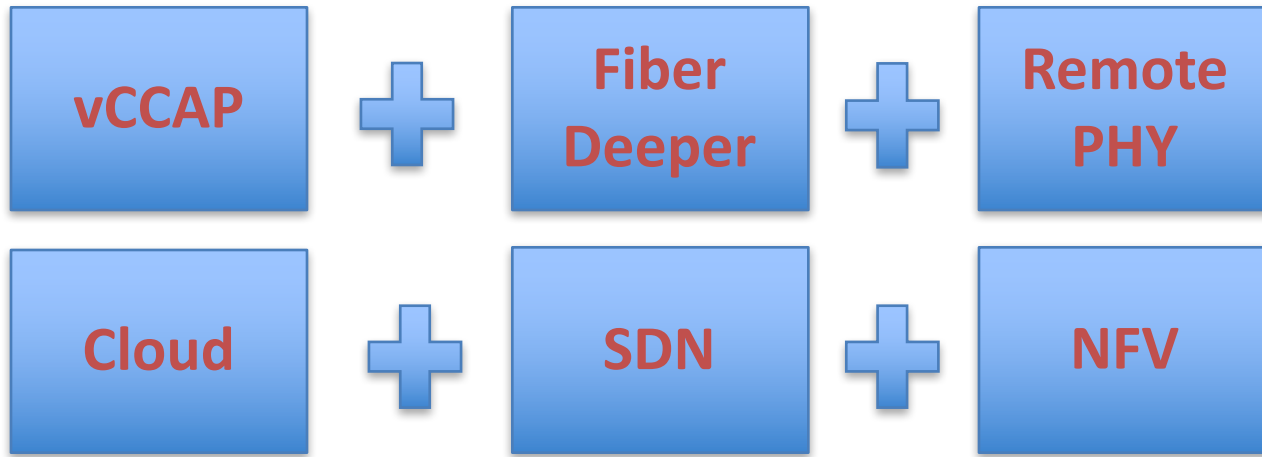
vCCAP runs on the servers in the HERD POD

As subscriber capacity increases, new virtual CCAP servers could be configured and new Remote PHY devices deployed to accommodate the increased bandwidth and subscribers.

CableLabs specs define a common CCAP architecture

- CableLabs Converged Cable Access Platform Architecture Technical Report
- CableLabs Operations Support System Interface Specification (OSSSI) defines the requirements necessary for the Configuration, Fault Management, and Performance Management of the Converged Cable Access Platform (CCAP) system
- CableLabs MAC and Upper Layer Protocols Interface Specification, CM-SP-MULPIv3.0
- The CableLabs Remote PHY technology is detailed by six specifications including:
 - The System Specification that describes System level requirements such as initialization sequences and security.
 - The R-DEPI and R-UEPI specifications that describe the downstream and upstream pseudowires and the L2TPv3 control plane.
 - The General Control Protocol (GCP) specification that defines a protocol used for configuration of Remote PHY Devices (RPD).
 - The R-DTI specification that defines the timing interface between the CCAP-Core and RPD.
 - The R-OOB specification that defines support for the SCTE55-1 and 55-2 out of band data for video applications.

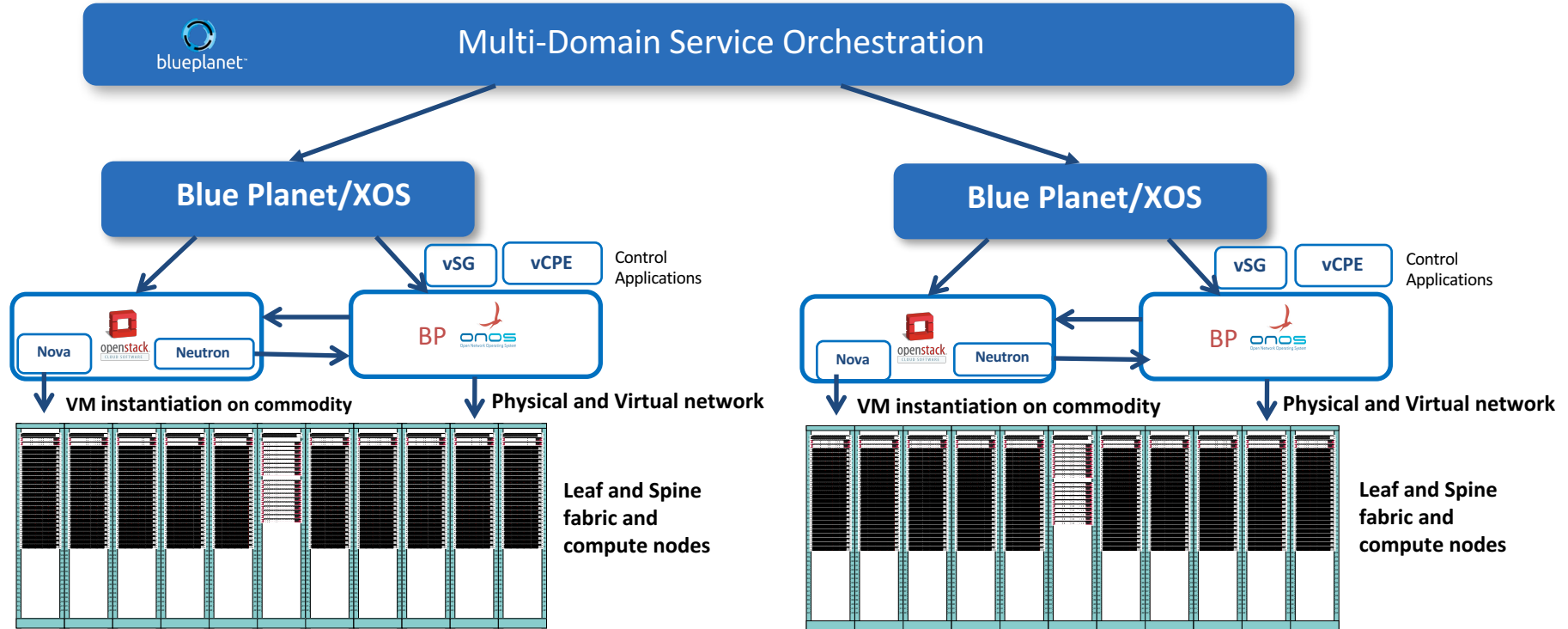
Webscale Head End Architecture



Virtualizing of CCAP onto HERD PODs will help move the Head End into the **Webscale** world bringing datacenter economies and fast service deployment to cable networks.

Current focus is on R-CORD. Future support might include Enterprise-CORD (E-CORD) and M-CORD

- Initial use case is for residential virtual OLT



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